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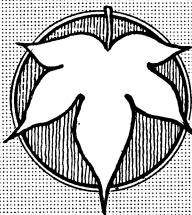
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The
**RED SPIDER
ON COTTON**
*and how to
CONTROL IT*



OWING to the minuteness of red spiders and to the fact that they live chiefly on the underside of the leaves which they attack, they are comparatively little known to the layman.

Their infestation of cotton, cultivated violet, garden bean, dahlia, sweet pea, and hollyhock gives much trouble to farmers, gardeners, and housewives, but the result of their work frequently is confused with "rusts."

The red spider is known to feed on 183 kinds of plants, of which 55 percent are cultivated and 45 percent are native wild species.

To prevent the spread of red spiders by eliminating weeds about fields and by destroying the pest on dooryard plants has been found possible, and as a control measure is of first importance.

By pulling and destroying the first few plants which show infestation the pest often may be stamped out.

Four different contact sprays have been found to be entirely satisfactory for use against the red spider on cotton. These are potassium sulphide, lime-sulphur, kerosene emulsion, and flour-paste solution, and the dilution for each spray is given on page 10. Dusting with sulphur flour is recommended for large-scale infestations. *Prevention is of vital importance, however, owing to the heavy expenditure of time, labor, and material which is necessary to control the pest when it is abundant in fields.*

THE RED SPIDER¹ ON COTTON AND HOW TO CONTROL IT

By E. A. McGREGOR, associate entomologist, Division of Fruit Insects, Bureau of Entomology²

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BY THE adoption of the preventive measures described in this bulletin it is possible to avoid the losses caused by the so-called "red spider" (fig. 1), a minute creature that causes serious injury to cotton in the Southern States. Injury by the red spider in cotton fields may occur from the middle of June until the middle of September. It consists in a rusting and dropping of the leaves and sometimes in the death of the affected plants over considerable portions of the fields. For many years this trouble has been called "rust" by cotton planters, who concluded from the reddening of the leaves that it was a disease. The injury, however, is caused by the presence on the cotton leaves of multitudes of small mites called "red spiders."

GENERAL APPEARANCE AND NATURE OF DAMAGE

The presence of the pest is first revealed by the appearance on the upper surface of the leaf of a blood-red spot. As leaves become more infested they redden or turn rusty yellow over the entire surface, become folded, then turn brown and dry, and finally drop. The lower leaves usually are first attacked, but infestation spreads upward until often only the bare stalk and 1 or 2 terminal leaves remain (see figs. 3, 4, and 5). Such plants almost always die.

The loss of foliage is always accompanied by the shedding of bolls, which may amount to the total loss of fruit or merely of the younger bolls, and in severe infestations the loss of the leaves may prevent the development of lint in the bolls that remain. On the plants other than cotton, which the red spider often attacks, the appearance of the injury is similar to that on cotton, although it is unusual for most plants to show the red blotching. The feeding is done by

¹ *Tetranychus bimaculatus* Harvey, formerly referred to as *T. telarius* L., and in some publications as *T. gloveri* Bks.; order Acarina, family Tetranychidae.

² At the time that this bulletin was originally prepared Mr. McGregor held the position of scientific assistant in the Division of Southern Field Crop Insect Investigations.

means of sharp, slender, lancelike mouth parts which are thrust well into the leaf, usually on the under surface.

Injury results from the extraction by the red spiders of the juices of the plant leaves. It is plain, therefore, that the mites cannot be

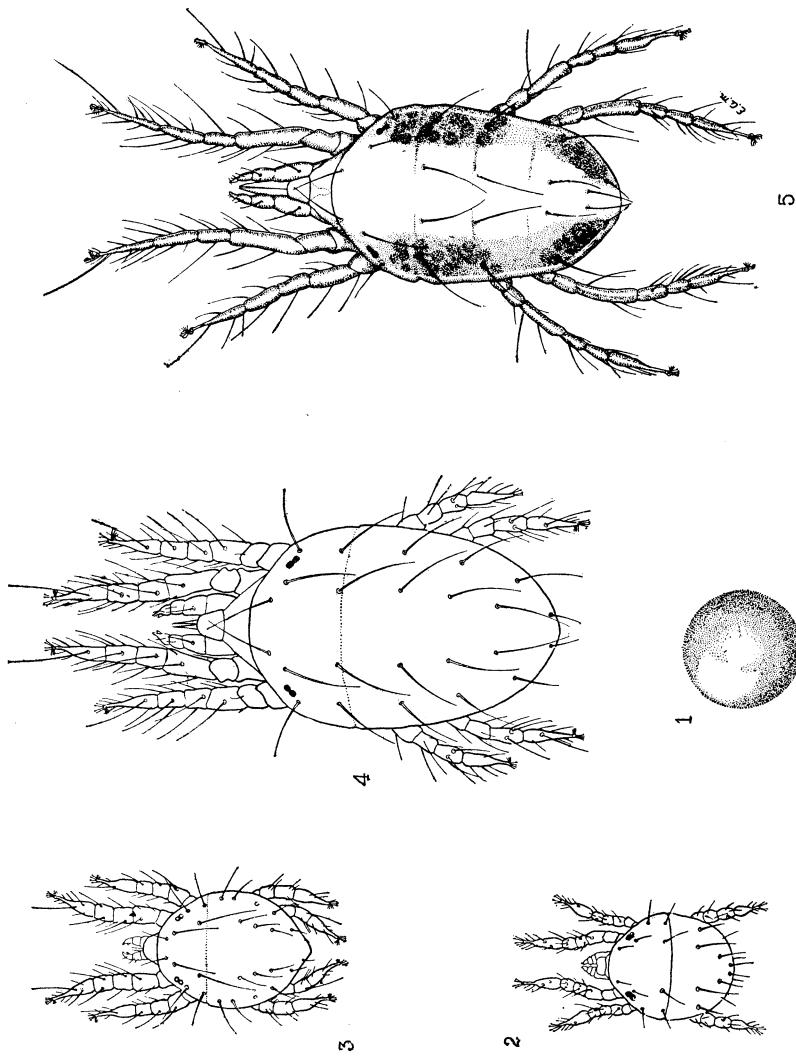


FIGURE 1.—The common red spider (*Tetranychus binaculatus*): 1, The egg; 2, the newly hatched larva; 3, the recently molted protonymph; 4, the mature deutonymph just prior to the final molt; 5, the adult female. Highly magnified. (McGregor and McDonough.)

killed by poisons sprayed on the leaves, to be devoured in feeding but must be attacked by sprays or dusts which kill by contact.

DISTRIBUTION IN THE SOUTHEAST

The common red spider is very generally distributed in the United States. The map (fig. 2), which contains 297 records³ of occurrence in 34 States, shows the distribution of the majority of reported cases.

³ Some of the reported occurrences of the "common red spider" in California and Oregon probably had to do with the Pacific mite, *Tetranychus pacificus* McG.

The majority of the occurrences in the Southeast are confined to a zone the outer margin of which lies from 60 to 80 miles from the coast, while the inner margin is from 200 miles (along the Atlantic coast) to 275 miles (along the Gulf coast) inland (fig. 2).

EXTENT OF INJURY

Unlike many pests, the red spider does not occur continuously over large areas. Certain fields are infested while many others are free. Large fields are probably never damaged throughout, but smaller fields frequently become wholly affected. A thorough examination of all fields within 1 mile of the center of Leesville, S.C., was made during the height of the season with a view to determining the exact state of red-spider infestation in one locality. In all, 99 fields

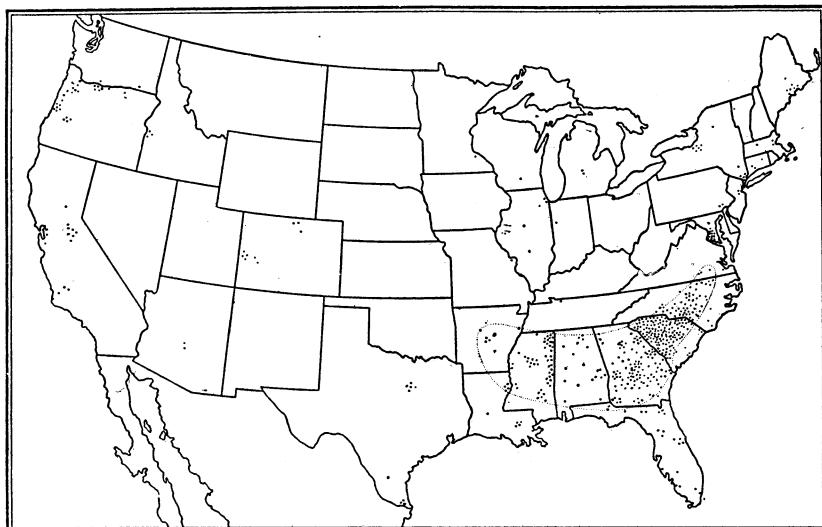


FIGURE 2.—Distribution of the common red spider. Dots represent specific reported occurrences; dotted line incloses the zone of heaviest occurrence in the Southeast. (McGregor and McDonough.)

were examined as carefully as possible, and about three fourths of them were found to be infested. This occurrence was one of the severest and most general that has at any time come to the writer's attention. The worst infestation in the above-mentioned locality was one which spread from its point of origin until it extended in one direction 600 feet from the original source (fig. 6). The area finally affected, semicircular in shape, comprised 13 acres, and within its boundaries the occurrence was general. While such a case as this is unusual, 4-acre or 5-acre spots with 25 to 100 percent damage are frequently seen.

During one season (1912) about 20,000 acres of cotton in South Carolina was seriously infested by the red spider. Since the yield thus lost is about two fifths of a normal crop on this area, or 2,716,000 pounds, it will be seen that at 12 cents a pound this lost lint represented a tax of \$325,920. The cottonseed lost, at 1912 prices amounting to \$67,900, brought the total levy on the South Carolina planters to about \$393,820. In view of the fact that North Carolina, Georgia,

Alabama, and Mississippi suffer similarly and are each considerably larger than South Carolina, it is estimated that during a severe red-spider year the Southeast may suffer a loss of \$2,000,000 from the ravages of this pest.

DESCRIPTION OF THE RED SPIDER

Both male and female red spiders are present on the plants. The color of the females is subject to considerable variation. At times it is rusty green, sometimes greenish amber, occasionally yellowish, at times almost black, but most often brick red, and a large spot of much darker color is usually seen along the back half of each side of the body. The males are considerably smaller than the females, more pointed behind, of a rusty salmon color, and the spots at the sides are not conspicuous. The red spider is in reality not a spider but a mite, and is more nearly related to the ticks than to the true spiders. As is usual with mites, both the male and the female have eight legs, but no wings. The females are less than one fiftieth of an inch in length and by close examination may be seen among the fine webs on the lower surfaces of the leaves.

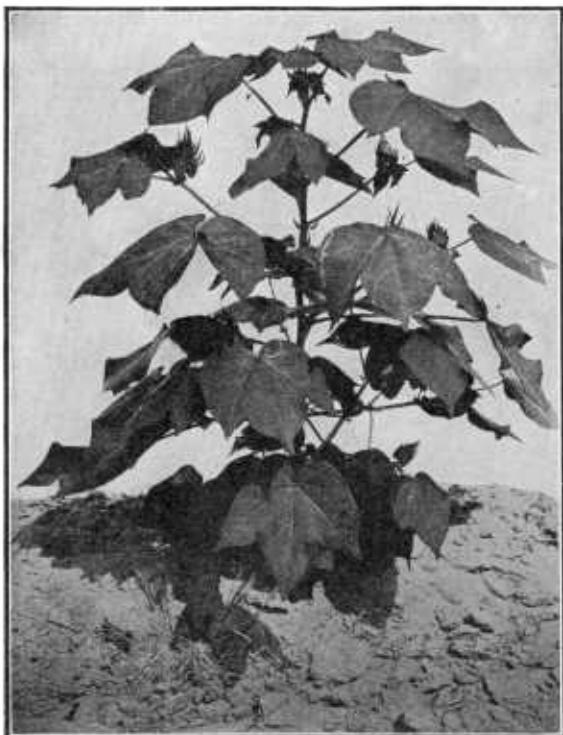


FIGURE 3.—An uninfested cotton plant, growing in same field shown in figure 6, but just beyond the boundary of infestation by the red spider.

through the winter are chiefly mature females. During periods of mild weather considerable development may take place, and the females may lay eggs. Upon several occasions at Batesburg, S.C., all stages of the red spider have been seen in winter on plants in outdoor locations. Feeding continues more or less, depending on the temperature, on several species of plants which bear leaves throughout the winter.

The great majority of red spiders pass the winter on wild plants, and since these plants support the mite during the time of year when it is most difficult for the pest to survive, it is clear that their elimination is of great importance. Among the more common of these winter plants are hedge nettle, evening-primose, Jerusalem-oak, wild blackberry, sowthistle, wild geranium, and wild vetch.

SEASONAL HISTORY AND HABITS

Males are sometimes seen during the winter, but the red spiders which pass

With the return of warm spring days the red spiders multiply much faster, until their winter food plants become too crowded to support them properly. New feeding grounds then become necessary, and migrations take place, which carry them to numerous species of spring plants and weeds.

The first spring generation of females usually develops about March 31. From this date until about May 31, when cotton becomes attractive to the pest, the red spider advances from the winter plants in several successive migrations. During this interval five broods of red spiders usually develop. In the meantime most weeds and garden plants that stand in the path of the red spider's advance have become infested.

During the spring and summer months the red spider, in the latitude of South Carolina, requires on an average a little less than 11 days for the completion of a generation. In an average season at Batesburg, S.C., there are 17 generations of red spiders.

In developing from the egg to the adult stage the red spider follows one or the other of two courses, depending on the sex. With the female, the egg hatches in about 4 days



FIGURE 4.—Cotton plant in an early stage of infestation by the red spider. Many leaves are discolored and some of the lower ones have dropped.



FIGURE 5.—Cotton plant in well-advanced stage of infestation by the red spider. Nearly all leaves, squares, and bolls have been shed.

season, the females require about 9 days to mature.

The development of the male is very similar to that of the female, with the difference that the secondary nymphal stage is lacking.

to a tiny, colorless, six-legged form known as a larva, which feeds eagerly and in about 2 days in the summertime sheds its skin and becomes an eight-legged form called the primary nymph. The latter feeds in a manner very similar to that of the larva and becomes greenish or yellowish in color, with conspicuous blotches at the sides. At Batesburg this stage requires a trifle over 2 days for completion, when the skin again is shed and the secondary nymph appears. The latter lives about as the preceding stages did and becomes more nearly the size and color of the adult. After about 1.9 days another molt or skin shedding occurs, which gives origin to the adult female. Thus, in the most favorable

The other stages, however, are slightly lengthened, so that the male red spiders usually complete their development only 1 day sooner than the females.

In establishing herself upon cotton, the female selects a concave area between the under veins of the leaf and after a brief feeding period of about 18 hours begins to deposit her eggs. Usually the eggs are clustered rather closely, rarely occupying an area greater in size than that of a dime. The female may lay from 6 to 9 eggs a day for from 8 to 12 days, laying a total of 50 to 110 eggs. The average is probably from 60 to 70 eggs. Feeding continues from time to time throughout the egg-laying period. The average duration of adult life in summer, in South Carolina, is about 12 days. This

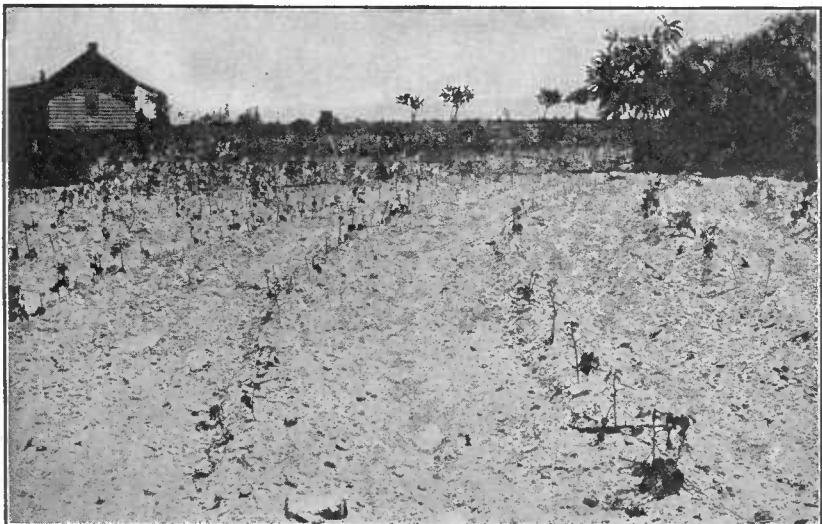


FIGURE 6.—A striking example of red-spider work in a cotton field. Nearly all the plants in the foreground are in the condition shown in figure 5. The source in this case was certain pokeweed stalks growing in the weed border seen in the upper right-hand corner of the picture.

period increases as the weather becomes cooler, and in winter the adults often live for 150 days.

RELATION OF WEATHER TO BREEDING

Climatic conditions influence the development of the red spider to a marked extent. The influence may be either harmful or beneficial. In the course of the year the occurrence of the pest undergoes many changes. During December, January, and February the red spider merely maintains itself, but during March conditions usually become a little more favorable. Through April and May development progresses most rapidly, and infestation reaches its height on miscellaneous plants by June 1. Beginning about the end of September there is a reduction in the numbers of the red spider, and this reduction continues as the weather becomes colder, until by the end of November the low point is again reached. Hot, dry conditions, such as occur during times of drought, hasten development, while cool, wet weather retards it. A female laying normally about 6 eggs a day will, upon the occurrence of a hot day, suddenly

increase the number, often to 15 or 20 eggs a day, or upon a chilly day the number deposited may drop as suddenly to 1 egg or none.

DISPERSION

When cotton and other annual plants die in the late fall the red spiders are forced to seek green food. Many of them manage to locate upon the several kinds of weeds (mentioned on this page) which remain green throughout the winter. Since these wild plants occur abundantly in the borders of fields and on terraces and roadsides, the pest frequently is found on cotton the following spring, in the portions of fields where planters fail to clear these borders of weeds.

The cultivated violet occurs frequently throughout the South, and remains green through the winter. Infested violet beds have been found from Virginia to Texas and in California, and in many cases they are the sources of infestation to nearby cotton fields. The infestation to cotton may arise directly from violets, if the beds are within a few hundred feet of cotton (fig. 7), or from a series of migrations covering considerable distances.

A peculiar sort of red-spider infestation arises from pokeweed, which occurs commonly on terraces and along field borders. It is attractive to red spiders in early summer, and often serves as an intermediate supporting plant to tide over the red spiders during the course of their migration from overwintering plants to cotton.

It has been found that adult females are able to travel over smooth surfaces at the rate of about 5 inches per minute, or 600 feet in 24 hours. When forced to migrate because of the scarcity of proper food, they commonly take to the ground and travel to other plants. During heavy rains many red spiders are dashed to the ground and carried considerable distances in the surface water, whereupon those not killed establish themselves on the plants that are nearby. Heavy winds also at times blow them from place to place. When the injury becomes severe in a portion of a field it is common for the red spider to travel directly from plant to plant by means of the interweaving branches.

PLANTS ATTACKED

The red spider has been found breeding on 183 kinds of plants, of which 55 percent are cultivated and 45 percent are native wild species. Weeds, ornamental plants, and garden and field crops are included. The commonly infested supporting plants in the Cotton Belt, arranged in the order of their susceptibility to red-spider attack, are cotton, cultivated violet, sowthistle, hollyhock, dahlia, garden beans, corn, tomato, onion, carnation, sweet pea, hedge nettle, nasturtium, morning-glory, clover, wild vetch, ironweed, Jerusalem-oak, wild geranium, evening-primrose, pokeweed, and strawberry.

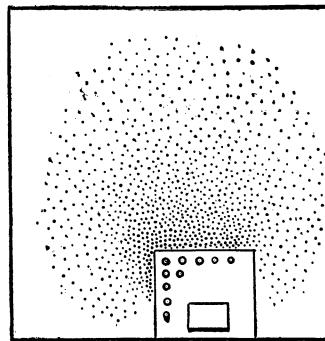


FIGURE 7.—Diagram showing how violets growing in dooryard give rise to red-spider infestation in adjoining cotton field. The infestation is most severe near the yard. This diagram is typical of many cases.

NATURAL ENEMIES

The red spider on cotton is known to be attacked by 31 predacious enemies, which render valuable assistance in its control. Of these, 5 are mites, 3 are thrips, 4 are bugs, 4 are lacewing flies, 2 are midges, 4 are syrphid flies, 8 are lady beetles, and 1 is a caterpillar. These predatory enemies, in turn, are known to be attacked by 75 species of predatory enemies and parasites.

REMEDIES FOR THE RED SPIDER

PREVENTIVE MEASURES

The red-spider problem must be solved through preventive efforts rather than curative if it is to be done with the greatest economy. The location of the mites through the winter and spring, their rapid development on a few wild and cultivated plants, and the manner of dispersion of the pest lead to the following cultural recommendations:

WEED DESTRUCTION

Many weeds and plants serve as sources of dispersion. By destroying, during the winter and early spring, pokeweed, Jerusalem-oak, jimsonweed, wild blackberry, wild geranium, and other weeds in and around cotton fields, the greatest step toward red-spider control will have been taken. This plan has been tested in several instances and has given complete immunity the following season.

CONTROL ON DOORYARD PLANTS

A few kinds of cultivated plants, especially violets, remain green through the winter and are well adapted to serve as winter hosts of the red spider. Many cases of cotton infestation can be traced to nearby dooryards. The beds of violets and other plants should be sprayed thoroughly as soon as they show signs of infestation. The most satisfactory procedure, where violets are concerned, is to remove or destroy them.

HERBICIDES

Certain chemical sprays can be applied to weeds that kill them rather quickly. In some cases it is easier to spray a chemical (fig. 8) than to work with tillage tools, but most of these chemicals are too expensive to be recommended for general use. The most commonly used and effective chemical weed killers are sodium chlorate, calcium chlorate, mineral oils (fuel oil or distillate), common salt, and sodium arsenite. These all have certain drawbacks that limit their usefulness, and they should be used only as recommended. Directions for the use of these and other herbicides may be obtained from the Bureau of Plant Industry, United States Department of Agriculture, Washington, D.C.

SPACING

Some have stated that infestation spreads through a field only by means of the interlacing cotton branches, and that by increasing the spacing the spread of the red spider can be prevented. Since it is now known, however, that the mites commonly travel on the ground also, from plant to plant, it is easily seen that wide spacing of cotton plants will by no means prevent the spread of the pest.

MAINTAINING MULCH

By maintaining continually in fields a finely pulverized surface mulch, the progress of migrating mites is somewhat retarded and the spread of an infestation correspondingly discouraged. The planting of cotton by the checker system permits the cultivation of each plant on four sides and is a good method from the viewpoint of the control of the red spider.

ROTATION

Since the wild grasses and small grains appear to be about the only plants that are free from red-spider attack, there are few immune crops which can be used for the purpose of rotation. Furthermore, provided the sources of infestation were allowed to remain, the pest

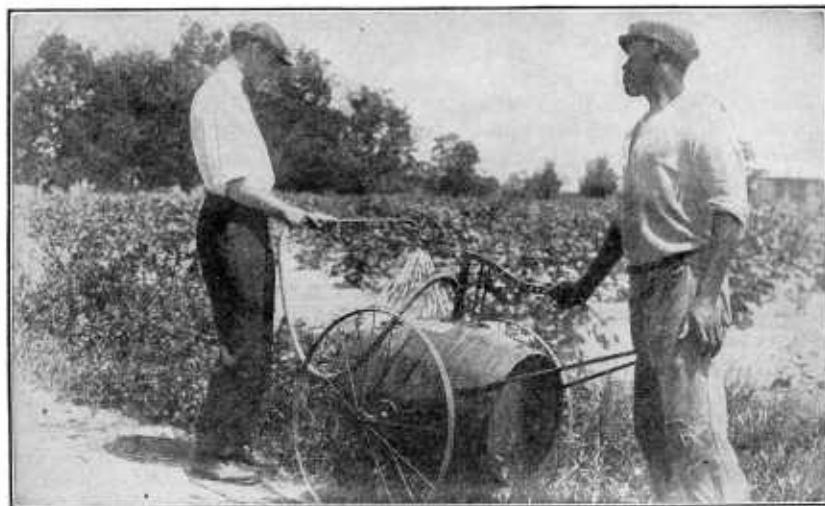


FIGURE 8.—Portable barrel pump for application of herbicide to weed borders.

would surely reinvade fields, upon the return to cotton, even should the small grains or grasses be planted for a time.

FERTILIZERS

Plants that are unhealthy and making poor growth from any cause are more subject to attack by red spiders than plants that are healthy and vigorous. Although the fertilizing of cotton land will not prevent infestation by red spiders, the judicious use of fertilizers discourages red spider development and invigorates the plants so that they are better fitted to overcome the injury.

REPRESSIVE MEASURES

Under the heading "Repressive Measures" may be discussed those measures which can be taken to combat the pest when it has gained entrance to cotton fields. It has been demonstrated that it is possible to eradicate the pest from infested fields.

By keeping a constant watch of cotton fields the earliest affected stalks may be detected and destroyed. In using this method it

usually is necessary to repeat the operation several times, since certain plants are likely to be overlooked during the first inspection. Great care should be taken to locate every plant that shows infestation, and these must be taken from the field without being brushed against healthy plants, and burned immediately. If infestation has not advanced too far, the prompt application of this method usually is effective.

If infestation has spread until a considerable patch has become involved, more drastic steps are necessary than those just mentioned. Where a continuous area of infestation occurs in a large field, it is often advisable to plow up the worst affected portion and spray the rest of the infested area in order to save the remainder of the field. The stalks should be quickly piled up and burned with the aid of straw or light trash. Such a severe measure should be resorted to in extreme cases only, and the planter concerned must be the judge of its advisability.

INSECTICIDES

Out of 75 different insecticides tested against the red spider on cotton, the following have been found to be satisfactory: (1) Potassium sulphide (1 ounce in 2 gallons of water). This material gave the best results of all the sprays tested, but it may be difficult to obtain in some localities. (2) Lime-sulphur (home-made or commercial). This is readily obtainable in most places. (3) Kerosene emulsion (2 gallons of kerosene to 12 gallons of water).⁴ (4) Flour-paste solution (1 gallon of stock paste⁵ to 12 gallons of water). This is immediately effective but does not possess any continuous effect. (5) Finely ground flour sulphur, 10 pounds to the acre.

The selection of the most suitable insecticide depends largely on the availability of materials and equipment and the area to be treated. In case the infestation is small and does not cover more than 1 or 2 acres, spraying with potassium sulphide, lime-sulphur, kerosene emulsion, or flour paste, or dusting with sulphur is recommended. In large-scale infestations it is more economical to dust at the rate of 10 pounds per acre with finely ground flour sulphur (95 percent or more of which will pass through a screen having 325 meshes to the inch).

When it is necessary to dust for the bollweevil at the same time, 8 pounds of sulphur mixed with 4 pounds of calcium arsenate may be used for each acre to be treated. The foregoing sprays and dusts, when properly applied, kill practically all the mites, but not the eggs; therefore *a second application 1 week later is necessary to kill any that have hatched since the first application*.

All the recommended insecticides kill the red spiders by contact with their bodies, and arsenical sprays are of no value as these mites do not eat the leaf tissues. Care should be taken to cover the under side of the leaves thoroughly. An elbow placed in the discharge pipe of the sprayer or duster to direct the insecticide upward assists in reaching the under surface of the leaves, especially when plants are small. Any available spraying or dusting machinery used for cotton

⁴ To make a kerosene emulsion take 1 gallon of soft water, one half pound of laundry soap, and 2 gallons of kerosene. Dissolve the soap in the water by boiling, add the kerosene immediately on removing the soapy water from the fire, and pump the mixture vigorously for about 10 minutes through a spray pump into another container. For spraying cotton, this stock mixture should be diluted with 11 gallons of water.

⁵ The stock flour paste is made by cooking 1 pound of flour with 1 gallon of water. Stir thoroughly till all lumps are broken up and the paste is smooth.

or other field crops can be adapted for controlling the red spider. A bucket, compressed-air, or knapsack spray pump is suitable for spraying small areas, and a hand dust gun is satisfactory for dusting areas up to several acres in size. In cases where the red spider has spread so as to involve a considerable acreage, it will be preferable to apply the sulfur by means of a traction or motor-driven field-crop duster.

SUMMARY OF REMEDIES

To prevent injury to cotton by red spiders the following steps should be taken: (1) Destruction of all weeds around the farm during the winter and early spring; (2) spraying of cultivated plants around the dwellings with a contact insecticide; (3) maintaining a finely pulverized surface soil; (4) destruction of early infested plants on large areas of heavy infestation by plowing up and burning; and finally, (5) spraying or dusting the cotton with any one of the recommended contact insecticides.

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